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21. Okt. 2003
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Prüfungsantrag, Einzahlungstag am 2. Juli 2002

Eingabe vom **eingegangen am**

Die Prüfung der oben genannten Patentanmeldung hat zu dem nachstehenden Ergebnis geführt.

Zur Äußerung wird eine **Frist von**

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A04

gewährt, die mit der Zustellung beginnt.

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In diesem Bescheid ist folgende Entgegenhaltung erstmalig genannt. (Bei deren Nummerierung gilt diese auch für das weitere Verfahren):

1. WO 98/13 721

Zusätzlich zu dem von der Anmelderin bereits gewürdigten Stand der Technik wurde noch die Druckschrift 1 ermittelt. Aus dieser Druckschrift ist eine gattungsgemäße Anzeigevorrichtung bekannt, bei der der Fi~~e~~ber-Optik-Abschnitt mit einem Material ummantelt ist, das verbiegbar ist, vgl. insbesondere Figur 1 mit zugehöriger Beschreibung auf S. 4, Z. 26 bis 30.

Der geltende Anspruch 1 lässt den zu diesem Stand der Technik bestehenden Unterschied nicht mit der erforderlichen Klarheit erkennen und ist deshalb nicht gewährbar.

Falls die Anmelderin in dem zum Stand der Technik bestehenden Unterschied noch Patentwürdiges sieht, so hätte sie dies ausführlich zu begründen und einen darauf gerichteten neuen Anspruch 1 einzureichen, aus dem der zum Stand der Technik bestehende Unterschied klar und deutlich zu entnehmen ist. Weiterhin hätte sie dann die konkrete technische Aufgabe in positiver Weise zu nennen, die durch den neuen Anspruch 1 gelöst wird.

Mit den vorliegenden Unterlagen kann der Anmeldung noch kein Erfolg in Aussicht gestellt werden.

Prüfungsstelle für Klasse **G 02 B**

Bischof

Dr. Bischof
Hausruf: 3031

Anlage:
Abl. d. Entgegenhaltung√

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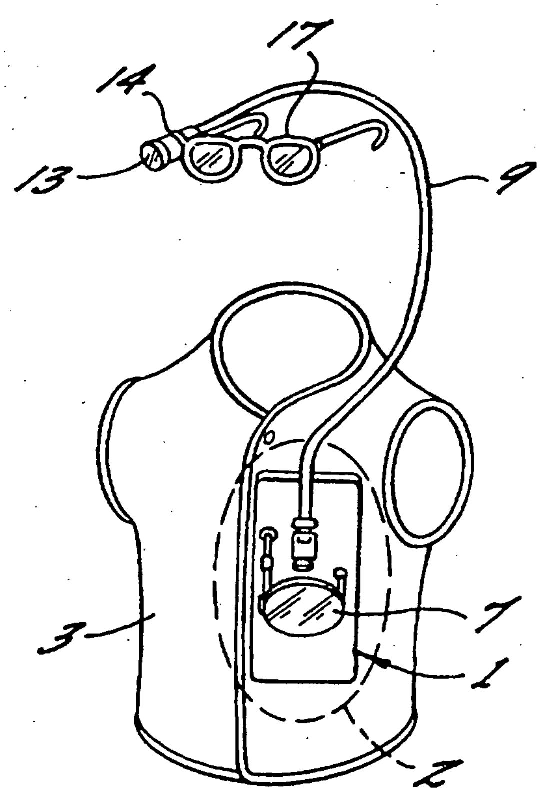
(54) Title: HEAD MOUNTED DISPLAY WITH FIBRE OPTIC IMAGE TRANSFER FROM FLAT PANEL

(57) Abstract

A body garment worn electronic digital computer system enclosed in a Faraday cage includes a flat panel output display within the cage for displaying images. A fiber optic transmission line couples images appearing on the flat panel output display to head mounted eyeglass frames where the image is transmitted to the wearer's eye by reflection off a mirror. Suitably the image appearing at the exit end of the fiber optic strand is focused by a focusing lens onto the mirror; and the distance between the end of the strand and the lens is adjustable. The head mounted display is compact and light weight to enhance portability of the system.



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HEAD MOUNTED DISPLAY WITH FIBRE OPTIC IMAGE TRANSFER FROM FLAT PANEL

FIELD OF THE INVENTION

This invention relates to head mounted display systems and, more particularly, to a body garment mounted electronic system, such as a digital computer system, whose display is mounted to the users head.

BACKGROUND OF THE INVENTION

The visual display of information that is output from an electronic device, such as a computer or television receiver, is necessary to communicate information to a person, who is to act on that information, such as an airport controller observing aircraft positions on a radar display, and/or be entertained, such as the lay person who watches the baseball game or opera on the television display. One may also interact with the displayed information, as in the case of modern video games and virtual reality systems. Further, one may acquire information of a technical nature useful for performing industrial maintenance procedures, such as diagnosing the anomalies, faults and failures as might occur in a complex system, such as an aircraft; and then following instructions, presented in text, animation and/or video, to resolve the abnormal condition.

At present in some electronic systems, notably virtual reality systems and augmented reality systems, the display is mounted upon the persons head and the visual display is output to the persons eyes, a system referred to as a head mounted display. The head mounted display offers a number of advantages: The display is never out of sight, even when the user turns his head, and the user's hands are free to carry on related activity.

Existing head mounted displays use an active matrix liquid crystal display or active matrix electroluminescent flat panel mounted in front of or above the user's eye. That arrangement poses problems for the user. The size of those displays range from about one inch by one inch by two inches in size to two inches by two inches by five inches in size and is not insignificant in weight. With such a display mounted only one or two inches from the user's eye, a significant amount of optical hardware protrudes into the user's field of view and, thereby, forces the user to suffer some inconvenience. If the unit is a "ruggedized" one, such as found in military application, the volume and weight are even greater and could pose problems for a soldier needing to enter or exit a confined area, desiring to lie prone on the ground, or crawl, or run and the like.

The bulkiness of the prior designs is discomforting to the user, particularly if it is necessary for the user to work in a confined space or view objects at close range. Many of these devices occlude the user's view, thus preventing binocular vision, making even simple tasks more difficult. Such bulkiness can also cause mechanical and electrical interference with attendant safety hazard. The display is a source of electromagnetic emissions. Those emissions may create electromagnetic interference and/or be monitored by surveillance systems.

An object of the invention, therefore, is to enhance the portability of electronic computer and other electronic systems that contain displays, and make the user's interface to the display more comfortable and convenient, allowing "hands-free" use.

And a further object of the invention is to provide a small, light weight head carried computer display for electronic systems offering a high quality display free of unwanted electromagnetic emissions and

electrically conductive materials that could pose a safety hazard.

SUMMARY OF THE INVENTION

In accordance with the foregoing objects a portable body garment worn electronic digital computer system enclosed in a Faraday cage includes a flat panel output display within that cage for displaying images. A fiber optic transmission line is provided for coupling images appearing on the flat panel output display to head mounted eyeglass frames where the image is transmitted to the wearer's eye by reflection off a mirror. Suitably the image appearing at the exit end of the fiber optic strand is focused by a focusing lens onto the mirror; and the distance between the end of the strand and the lens is adjustable.

The invention eliminates electromagnetic emissions, reduces bulkiness to the level attendant to an ordinary pair of spectacles, eliminates electrical and mechanical hazards and affords a convenient interface on which to receive information, both text and image.

The foregoing and additional objects and advantages of the invention together with the structure characteristic thereof, which was only briefly summarized in the foregoing passages, becomes more apparent to those skilled in the art upon reading the detailed description of a preferred embodiment, which follows in this specification, taken together with the illustration thereof presented in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

Figure 1 is a pictorial illustration of an embodiment of the invention;

Figure 2 is a pictorial illustration of a portion of Fig. 1, drawn in larger scale; and

Figure 3 is a pictorial illustration of another portion of Fig. 1, also drawn in larger scale to show additional details of the embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The head mounted viewer and electronic system is generally illustrated in Fig. 1 to which reference is made. As there shown a digital computer 1 or other electronic apparatus is supported upon a user's body within the cloth material of a garment that serves to package the computer, such as vest 3, or any other body-mounted packaging technique, such as a belt, a backpack or the like. The computer includes a flat panel display symbolically illustrated as 5. The entire computer and flat panel display is enclosed in a Faraday cage 2, a conventional electromagnetic energy shielding device, represented by dash lines. A pair of spectacles or eyeglass frames 7, as variously termed, is connected by a length of fiber optic cable 9 that serves as a light transmission line, to the vicinity of the flat panel display. The fiber optic cable extends from the flat panel display and through the Faraday cage to the eyeglass frames. Fiber optic cable 9 may be formed of a single fiber optic strand or a bundle of such strands, as desired. At least a portion of the length of fiber optic cable 9 and, preferably, the entire length of that cable is ensheathed or covered by a metallic conductor, forming a coax-cable like structure, and that metallic covering is grounded to the Faraday cage that encloses the computer. The foregoing eliminates electromagnetic emissions. The eyeglass frames serve as an appliance that mounts an end of the fiber optic cable to a user's head.

Reference is made to Fig. 2 which illustrates the lower end of fiber optic line 9 and flat panel

display 5 in an enlarged partial side view. The optic line's lines metallic sheath, earlier referred to, is illustrated in dash lines **9b**. As illustrated the entrance or input end of fiber optic light transmission line 9 is supported by bracket **10** in spaced relationship to a printed circuit board **6** that forms a part of the computer system, partially illustrated in edge view, and in spaced relation to a polished mirror 7, and flat panel display 5. A convex lens 11 is positioned in front of the entrance end of fiber optic line 9 held in place by bracket **12**. Mirror 7 is supported by bracket **8** oriented at an angle, suitably forty five degrees, to the display surface of display panel 5, and to lens **11**.

Circuit board **6** is a rigid dielectric board containing the printed circuit wiring for associated electronics equipment and electronic components at least for supplying operating power to the display panel. As specific example the circuit board contains the video output and power circuits for a digital computer and the digital computer is included on that circuit board. It is appreciated that the details of those electronic computer and display circuitry does not form a part of the present invention and is not necessary to understand of the invention so those circuits need not be further described.

In operation, mirror **7** receives the image displayed and projected from the front of the display panel and reflects that image in a different direction. Lens **11** is positioned to receive that reflected image and focus that image on the entrance of fiber optic line 9.

Reference is made to Fig. 3 which illustrates to a larger scale the mechanical arrangement of the remaining elements of the display that is positioned on the right side of eyeglass frames **7** in Fig. 1. This end includes fiber optic line 9, lens **13** and beam

splitter mirror 15. As pictorially illustrated, the output or exit end of the fiber optic line 9 is clipped to a side of the frame. Convex lens 13 is centered at the front of a cylindrical tubular clip 14 that slips over the end of fiber optic line 9 and is supported by that line. The clip allows the distance between the lens and the end of the fiber optic line to be adjusted, thereby varying the focal point of the lens.

Mirror 15 is a beam splitter mirror, it reflects some of the incident light, but allows a portion to pass through. Mirror 15 is mounted on a universal joint 16, such as a ball and socket joint. This allows easy adjustment of the mirror's position and allows the mirror to be flipped out of the way when desired.

For operation, lens 13 is adjusted in position to focus on mirror 15. In operation, the image transmitted through fiber optic line 9 exits the end of the line and is enlarged and focused by lens 13 onto mirror 15. In turn mirror 15 reflects that incident image into the user's eye. The lens and mirror arrangement magnifies the fiber optic transmitted flat panel display image, such that the image is projected in front of, and to the top, bottom or side of the eye, for convenient positioning as best suits the user. In less preferred embodiments, a concavely curved mirror, which provides some magnification, can be substituted for the flat mirror 15, should it be desired to eliminate lens 13. In essence the first image generated by the computer system at flat panel display 5 is transferred to mirror 15 located in front of the user's eye. That mirror serves thus as the electronic systems display.

In the foregoing operation, optically, mirror 7 reverses the incident image, left to right, producing a "mirror image" at the entrance end of fiber optic line 9. Mirror 15 at the eye end of the fiber optic

line on which the reversed image is incident, provides an additional reversal and thereby produces a correct image at the user's eye.

The size of mirror 15 is determined by the computer monitor field of view desired, which, typically, is on the order of plus or minus ten to twenty degrees from center, and by the apparent focal distance from the eye. When mounted on eyeglasses at a distance of approximately one inch from the eye, the mirror should be approximately between one-half inch to one inch in diameter. The mirror need be only one quarter inch or less in thickness. It is very light and thin. It is located at the same distance to the eye as the standard eyeglass lens. This allows the user an unobstructed view of both the flat panel display and the immediate environment.

The foregoing fiber optic head mounted viewer and computer system leaves the user's hands free of the necessity of carrying any components of the electronic system and offers great convenience. Since the system incorporates a beam splitter mirror, the user is permitted binocular vision of the image, while walking or working on an object. It is apparent that the weight, volume and moment of inertia of the disclosed combination is far less than conventional head mounted displays, and, accordingly, is more comfortable for the user. All electronics are buried within the user's garment, a vest, and are totally enclosed in a Faraday Cage, thus eliminating leakage of electromagnetic fields as could cause electromagnetic interference, electrical shock or discharge nearby explosives.

Adaptations to the foregoing system become apparent. A photosensitive neutral density filter may be incorporated to provide an appropriate contrast ratio for viewing the display image under widely varying lighting conditions. Optical filters and baffles can be incorporated to minimize glare or

exposure to laser beams. The viewer arrangement is shown attached to a standard eyeglass frame which appears most convenient. Alternatively it may be attached to a helmet, cap or headband that the user might choose to wear.

As those skilled in the art appreciate, more than one such system can be worn and used simultaneously. Two or three mirror and fiber optic devices of the foregoing type may be positioned on either side of the user's head in the vicinity of the user's eye. Multiple views and/or separate images can thus be observed virtually simultaneously.

In still other embodiments a single mirror may be used at the image generating device located on the circuit board; and the image displayed on that device viewed directly, such as with a standard fiber optic device. In that embodiment the flat panel display should be mirror image reversed to provide the correct view of the image at the eye. That image reversal on the flat panel display is accomplished in the electronic circuitry using known circuit design techniques. Alternatively, the fiber optic and lens can be located directly above the image generating device on the circuit board and the mirror can be located at the opposite end of the fiber optic, wherein the mirror is used to project the image for viewing. Again, in this instance, image reversal is required by the electronic circuitry.

It is believed that the foregoing description of the preferred embodiments of the invention is sufficient in detail to enable one skilled in the art to make and use the invention. However, it is expressly understood that the detail of the elements presented for the foregoing purpose is not intended to limit the scope of the invention, in as much as equivalents to those elements and other modifications thereof, all of which come within the scope of the

invention, will become apparent to those skilled in the art upon reading this specification. Thus the invention is to be broadly construed within the full scope of the appended claims.

THAT WHICH IS CLAIMED IS:

1. A head mounted viewer for a person to enable viewing of the information outputted by an electronic system of the type containing a flat panel visual display comprising:

an eyeglass frame for mounting to the persons head, said eyeglass frame containing first and second eye loops for positioning in front of said persons eyes;

a first mirror:

said first mirror positioned adjacent said flat panel display and oriented at an angle thereto for receiving from one direction the image generated on said flat panel display and reflecting such image in a different direction and reversing said image, whereby said reflected image is reversed from that image appearing on said flat panel display;

an elongate fiber optic strand for conveying images;

said fiber optic strand having an input end for receiving light images and an output end for expressing light images received at said input end;

first convex lens means; said first lens means being positioned adjacent said input end of said fiber optic strand for focusing images reflected from said first mirror upon said input end; of said fiber optic strand;

means coupling said output end of said fiber optic strand to said eyeglass frame;

a second mirror;

said second mirror being positioned on said eyeglass frame adjacent one of said eye loops for receiving an image and reflecting a reversed image into said person's eye;

second convex lens means;

said second convex lens means for focusing an enlarged image from said output end of said fiber optic strand onto said second mirror; whereby said image on said flat panel display means is transferred into the person's eye.

2. The invention as defined in claim 1, wherein said electronic system comprises a computer system; wherein said flat panel display is positioned overlying the person's chest.

3. In a portable electronic digital computer system for wear on a human torso, said computer system including a flat panel output display for displaying images output from said computer system for viewing by a person, the combination comprising:

Faraday cage means for enclosing said computer system;

garment means for supporting said Faraday cage and said encaged computer system on a torso;

head mounted viewer means for enabling viewing of said images, said head mounted viewer means comprising:

an eyeglass frame for mounting to a head of said torso, said eyeglass frame containing first and second eye loops for positioning in front of said head;

a first mirror within said Faraday cage:

said first mirror positioned adjacent said flat panel display and oriented at an angle thereto for receiving from one direction the image generated on said flat panel display and reflecting such image in a different direction and reversing said image, whereby said reflected image is reversed from that image appearing on said flat panel display;

an elongate fiber optic strand for conveying images;

said fiber optic strand extending through said Faraday cage and having an input end for receiving light images and an output end for expressing light images received at said input end;

an electrically conductive member enclosing at least a portion of the length of said elongate fiber optic strand, said member being electrically connected to said Faraday cage;

first convex lens means within said Faraday cage, said first convex lens means being positioned adjacent said input end of said fiber optic strand for focusing images reflected from said first mirror upon said input end of said fiber optic strand;

means coupling said output end of said fiber optic strand to said eyeglass frame;

a second mirror, said second mirror comprising a beam splitter mirror;

universal joint means for mounting said second mirror to said eyeglass frames;

said second mirror being positioned on said eyeglass frame adjacent one of said eye loops for receiving an image and reflecting a reversed image into said person's eye;

second convex lens means;

said second convex lens means for focusing an enlarged image from said output end of said fiber optic strand onto said second mirror; whereby said image on said flat panel display means is transferred into the person's eye;

cylindrical lens support means mounted to said fiber optic strand and positionable along the axis of said fiber optic strand; said second convex lens being mounted to an end of said cylindrical lens support means, whereby said support means permits adjustment of the distance between said lens means and said exit end of said fiber optic strand.

4. A portable digital computer system comprising;

portable digital computer means having a flat panel display means;

Faraday cage means for enclosing said portable digital computer means;

garment means for supporting and enclosing said Faraday cage means and said portable digital computer means upon a human torso:

an eyeglass frame for mounting to a head associated with said human torso, said eyeglass frame containing first and second eye loops for positioning in front of said head;

a first mirror:

said first mirror positioned within said Faraday cage adjacent said flat panel display means and oriented at an angle thereto for receiving from one direction the image generated on said flat panel display means and reflecting such image in a different direction and reversing said image, whereby said reflected image is reversed from that image appearing on said flat panel display;

an elongate fiber optic strand for conveying images through said Faraday cage;

an electrically conductive member enclosing the length of said elongate fiber optic strand, said member being electrically connected in common to said Faraday cage;

said fiber optic strand having an input end for receiving light images and an output end for expressing light images received at said input end;

first convex lens means; said first lens means being positioned adjacent said input end of said fiber optic strand for focusing images reflected from said first mirror upon said input end of said fiber optic strand;

means coupling said output end of said fiber optic strand to said eyeglass frame;

a second mirror;

said second mirror being positioned on said eyeglass frame adjacent one of said eye loops for receiving an image and reflecting a reversed image into said person's eye;

second convex lens means; and

said second convex lens means for focusing an enlarged image from said output end of said fiber optic strand onto said second mirror; whereby said image on said flat panel display means is transferred into the person's eye.

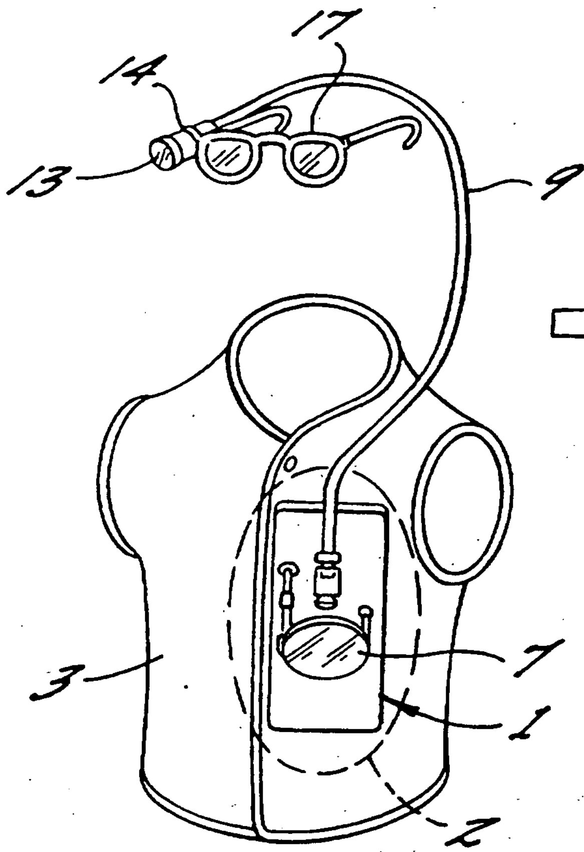

Fig. 1.

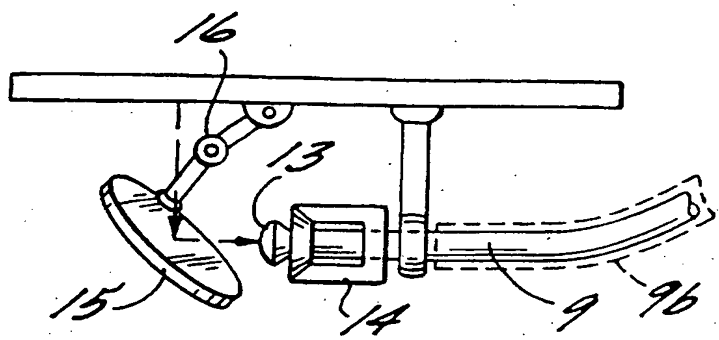

Fig. 2.

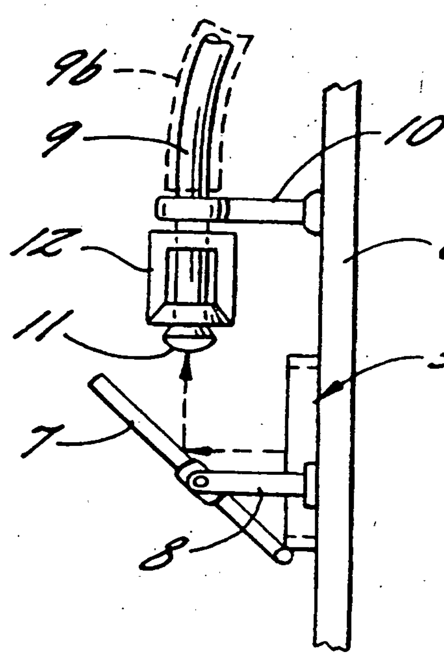

Fig. 3.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 97/17180

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G02B27/01 G06F1/16 G02C9/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G02B G06F G02C H04N G09G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4 735 473 A (MIGOZZI JEAN B ET AL) 5 April 1988	1
A	see column 2, line 63 - line 66 see column 4, line 16 - line 31; figure 6 ---	2-4
Y	US 4 806 011 A (BETTINGER DAVID S) 21 February 1989	1
A	see column 1, line 43 - line 56 see column 3, line 28 - line 49; figure 4 see column 4, line 30 - line 34 ---	2-4
A	GB 2 292 038 A (LAM DAVID CHOON SEN) 7 February 1996 see page 5, paragraph 4; figures 1,4 --- -/--	1,3,4

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
18 December 1997	- 9. 01. 98

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